FAA-E-2325d

January 3, 1984
SUPERSEDING
FAA-E-2325c dated 3/24/76
and AMENDMENT 1 dated 6/1/76

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

MEDIUM INTENSITY APPROACH LIGHTING SYSTEM
WITH RUNWAY ALIGNMENT INDICATOR LIGHTS (MALSR)

1. SCOPE

1.1 Scope.- This specification covers the major equipment items used in a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) for installation in a runway approach area.

2. APPLICABLE DOCUMENTS

2.1 FAA documents.- The following FAA documents of the issues in effect on the date for invitation-for-bids or request-for-proposals form a part of this specification and are applicable to the extent specified herein.

2.1.1 FAA specifications

FAA-E-982g	PAR-56 Lampholder
FAA-E-1100	Photometric Test Procedures for Condenser-Discharge Lights
FAA-G-2100c	Electronic Equipment, General Requirements for
FAA-D-2494/1a	Instruction Book Manuscripts, Technical; Electronic Equipment and Systems Requirements, Part 1

FAA-D-2494/2a	Instruction Book Manuscript, Technical; Electronic Equipment And Systems Requirements, Part 2
FAA-E-2604	Low-Impact Resistance Structures for Medium Intensity Approach Lighting System (MALS)
FAA-E-2702	Low-Impact Resistant Structures

2.1.2 FAA standards

FAA-STD-013	Quality Control Program Requirements
FAA-STD-021	Configuration Management (Contractor Requirements)

2.1.3 FAA drawings

C-6046	Frangible Coupling, Type 1 and 1A, Details
C-21216	Standard Nameplate
D-5140-2	Type JB-2 Junction Box
D-6155-2	ALSF-2 (6'-128') and MALSR (40'-128') LIR Structures, Light Mounting Height 40'-1"-128' TEE, TEE BAR and Tube Cap Assemblies
D-6213-15	MALSR W/Threshold Lights and Low-Impact Resistance Structure, 40'-0" To 128'-0" Mounting Height, LIR Wiring

2.2 Military and federal publications.- The following military and federal publications of the issues in effect on the date of the invitation-for-bids or request-for-proposals form a part of this specification and are applicable to the extent specified herein.

2.2.1 Military specifications

MIL-T-27	Transformers and Inductors (Audio, Power, and High-Power Pulse), General Specification for
MIL-HDBK-217	Reliability Prediction of Electronic Equipment
MIL-HDBK-472	Maintainability Prediction
MIL-T-704	Treatment and Painting of Material
MIL-C-7989	Cover, Light Transmitting, for Aeronautical Lights, General Specification for
MIL-A-8625	Anodic Coatings, for Aluminum and Aluminum Alloys
MIL-P-15024	Plate, Tags, and Bands for Identification of Equipment
MIL-E-17555	Electronic and Electrical Equipment, Accessories, and Repair Parts, Packaging and Packing of

MIL-C-25050	Color, Aeronautical Lights and Lighting Equipment, General Requirements for (Asg)
MIL-I-46058	Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)

2.2.2 Military standards

MIL-STD-276	Impregnation of Porous Nonferrous Metal Castings
MIL-STD-454	Standard General Requirements for Electronic Equipment
MIL-STD-461	Electromagnetic Emission and Susceptibility, Requirements for the Control of Electromagnetic Interference
MIL-STD-462	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-470	Maintainability Program Requirements (for Systems and Equipments)
MIL-STD-471	Maintainability Demonstration
MIL-STD-781C	Reliability Tests, Exponential Distribution
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810C	Environmental Test Methods

2.2.3 Federal specifications

QQ-A-200/9	Aluminum Alloy Bar, Rod, Shapes, Tube, and Wire, Extruded, 6063
QQ-A-225	Aluminum and Aluminum Alloy Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished, General
QQ-A-250	Aluminum and Aluminum Alloy Plate and Sheet, General Specification for
QQ-P-416	Plating, Cadmium (Electrodeposited)
QQ-A-591	Aluminum Alloy Die Castings
QQ-A-601	Aluminum Alloy Sand Castings
TT-E-485	Enamel, Semigloss, Rust-Inhibiting
TT-E-489	Enamel, Alkyd, Gloss, (for Exterior and Interior Surfaces)

TT-P-641	Primer, Paint, Zinc Dust-Zinc Oxide (for Galvanized Surfaces)
TT-P-645	Primer, Paint, Zinc-Chromate, Alkyd Type
TT-P-1757	Primer Coating, Zinc Chromate, Low-Moisture Sensitivity

2.2.4 Federal standard

FED-STD-595	Colors

2.2.5 Rome Air Development Center (RADC) publication

RADC-TR-75-22, AD A005657	Nonelectronic Reliability Notebook, Revised

2.3 Other publications.- The following publications of the issues in effect on the date of the invitation-for-bids or request-for-proposals form a part of this specification and are applicable to the extent specified herein.

2.3.1 American National Standards Institute (ANSI) publications

C62.1	Quantities and Units Used in Electricity
C89.1 - 1961	American Standard Requirements and Terminology for Specialty Transformers (NEMA Pub. No. ST 1-1961).

2.3.2 National Fire Protection Association (NFPA) publication

NFPA No. 70	National Electrical Code

2.3.3 National Electrical Manufacturers' Association publication

NEMA FA1-3.01	Vibration Testing

2.3.4 American Society for Testing and Materials (ASTM) standard

ASTM B633-78	Zinc on Iron and Steel, Electrodeposited Coatings of

(Copies of this FAA specification and other applicable FAA documents may be obtained from the Contracting Officer in the office issuing the invitation-for-bids or request-for-proposals. The requests should fully identify material desired, i.e., standard, drawing, specification, and amendment numbers and dates. Requests should cite the invitation-for-bids, request-for-proposals, or contract involved or other use to be made of the requested material.)

(Information on obtaining copies of military specifications and drawings may be obtained from the U.S. Navy Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania, 19120.)

(Information on obtaining copies of federal specifications and standards may be obtained from the General Services Administration offices in Washington, D.C.; Atlanta; Auburn, Washington; Boston; Chicago; Denver; Fort Worth; Kansas City, Missouri; Los Angeles; New York; and San Francisco.)

(Information on obtaining RADC publications may be provided by the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.)

(Information on obtaining ANSI standards will be provided by the American National Standards Institute, 70 East 45th Street, New York, New York.)

(Information on obtaining NFPA documents may be obtained from the National Fire Protection Association, Battery March Park, Quincy, Massachusetts, 02269.)

(Information on obtaining NEMA standards may be obtained from the National Electrical Manufacturers' Association, 155 East 44th Street, New York, New York.)

(Copies of ASTM standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Equipment to be furnished by the contractor.- The equipment to be furnished under this specification for each MALSR system shall consist of the items listed below.

(a) 45 Lampholder assemblies for PAR-38 lamps (3.2.2.2)

(b) 18 Lampholder assemblies for PAR-56 lamps (3.2.2.1)

(c) 1 Aiming device (3.2.3)

(d) 1 Control cabinet (3.2.4)

(e) 1 Power transformer unit (3.2.5)

(f) 2 Lightning arresters (3.2.5.3)

(g) 5 Sequenced flasher assemblies (3.2.6)

(h) 2 Mating connectors for remote maintenance monitoring (3.4.9.1)

(i) 2 Mating connectors for the individual control cabinet and the flasher tester (3.2.6.4.1)

(j) 5 Junction boxes (3.2.7)

(k) 1 Flasher tester (3.2.8)

(m) Site spare parts (3.2.9)

(n) Instruction book (3.13.1)

3.1.1 Other equipment.- Equipment required for the MALSR system, but notfurnished under this specification, includes PAR-38 150-watt (W), 120-volt (V) spot lamps; PAR-56 300-W, 120-V threshold spot lamps; frangible couplings;low-impact resistance structures; 2-inch (5.08 centimeters (cm)) electrical metallic tubing (emt)conduit; L-850B and L-850E semiflush lighting fixtures; and 300 watt,

240/45.5 V and 200 watt, 240/32.3 V direct earth burial (DEB) transformers for semiflush lighting fixtures.

3.2 General functional requirements.- The MALSR system shall consist of all equipment components listed in 3.1(a) through 3.1(n). The installed equipment shall be configured as a system with 18 threshold lights, consisting of 18 300-W, 120-volt, PAR-56 spot lamps; 9 light bars, each of which shall feature 5 steady burning PAR-38 spot lamps; a power and control station; and 5 sequenced flasher assemblies. The equipment will be installed in the approach area of the runway to provide visual guidance to aircraft during approach for landing. The flasher light units (3.2.6.5) shall be installed at regular intervals, and be arranged and connected to produce a sequenced flashing light signal having the appearance of a ball of light traveling down the system twice a second, from the flasher assembly farthest from the runway threshold to the flasher assembly closest to the runway threshold. All lights in the system, both steady burning and flashing, operate on three different intensity steps. Control of the steady burning light intensities shall be accomplished by the control cabinet which supplies three voltage steps to the primary of the power transformer (3.2.5). The control cabinet shall also provide power and intensity control signals to the individual sequenced flasher assemblies. The intensity of the flasher lights shall be changed by switching capacitors in the flasher individual control cabinet (3.2.6.4). The capacitors will be controlled by signal voltages from the control cabinet. A selector switch shall be installed in the control cabinet to turn the flashers on and off, only when the steady burning lights are on. Figures 1 and 2 show the MALSR configuration and the relationship of units in the MALSR system.

3.2.1 System operation requirements.- The MALSR system shall have the capability of being operated locally and remotely. The system shall be operated locally as specified in 3.2.4.2.3. Remote operation shall be accomplished through the remote control input (3.2.4.2.2) to the control cabinet. Remote control shall provide for setting the MALSR system at one of three intensity steps, for turning on/off the sequenced flasher lights while maintaining intensity control on the steady burning lights, and for turning off the entire system. The intensity of the steady burning lights shall be controlled as shown in table I.

Table I. Percent Relative Intensity

Step	Steady Burning Lights
High	100%
Medium	20%
Low	4%
Off	0%

3.2.2 Light bar equipment.- The equipment described in the following subparagraphs shall be furnished with each system for use on the steady burning light bars. Quantities required per system shall be as listed in 3.1.

3.2.2.1 PAR-56 lampholder assembly.- The PAR-56 lampholder assembly shall be in accordance with FAA-E-982g, except that the shorting device need not be provided for the MALSR system. The mounting base shall permit rigid mounting of the complete lampholder assembly as described in 3.2.2.4(a).

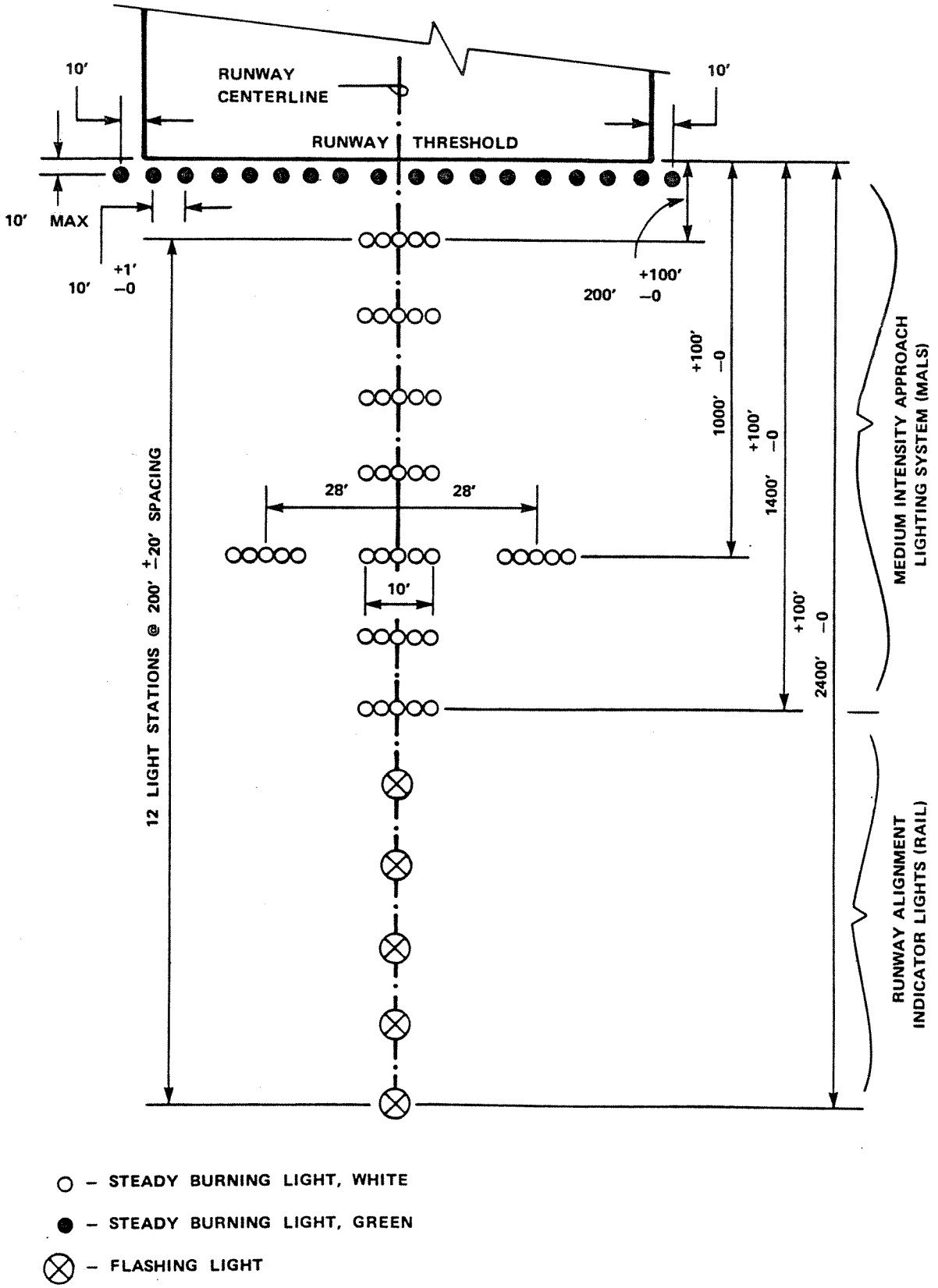

Figure 1. MALSR Configuration

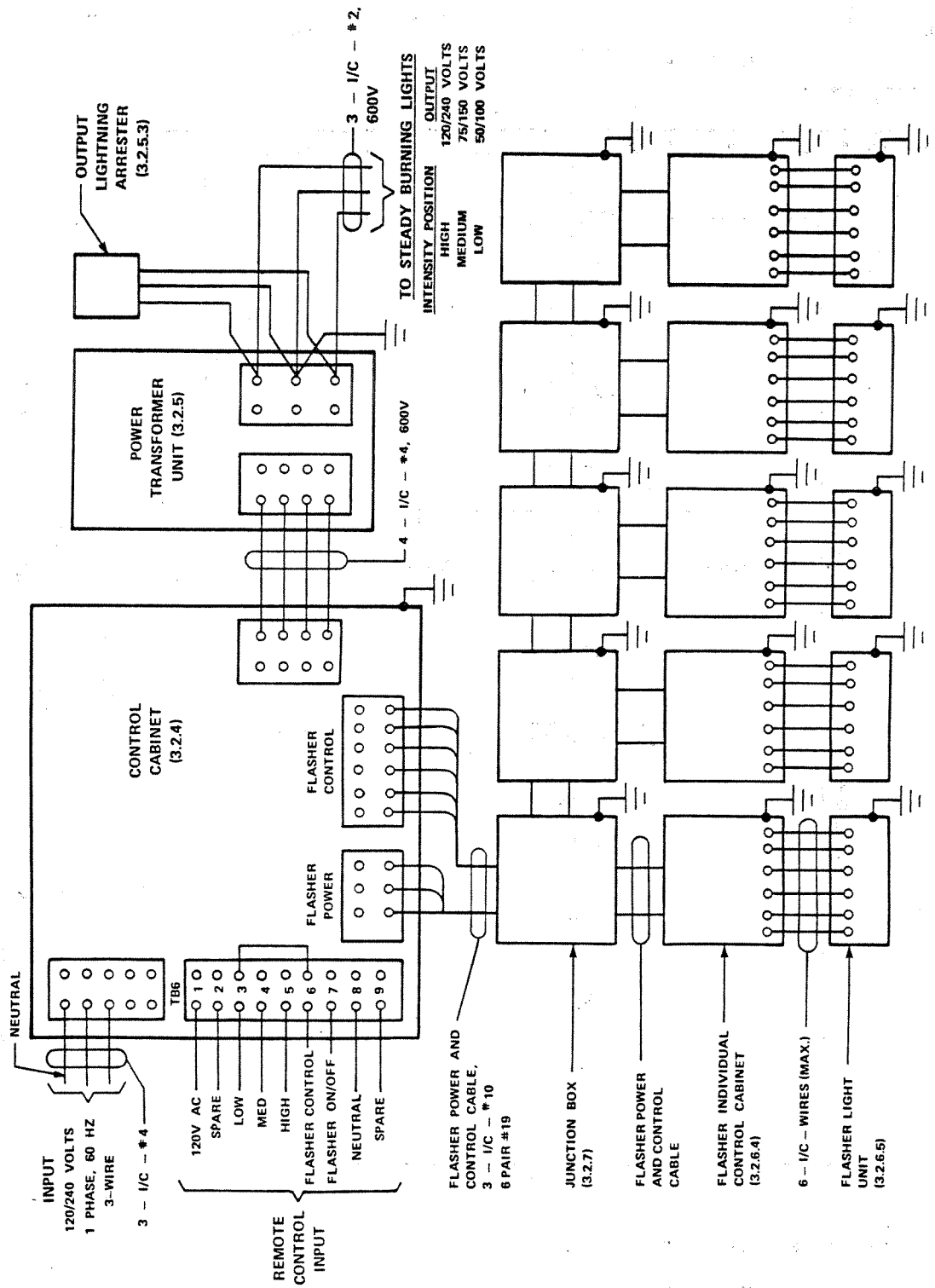

Figure 2. Functional Relationship of Units, MALSR

3.2.2.2 PAR-38 lampholder assembly.- The PAR-38 lampholder assembly consisting of lampholder, socket, and mounting base, shall be designed to accommodate 150-watt, 120-volt, PAR-38 spot lamps. All metal parts of the lampholders (including mounting base) shall be fabricated from cast aluminum or other suitable nonferrous metal. An anodized coating shall be required on aluminum in accordance with MIL-A-8625. Copper-bearing hardware in contact with aluminum shall be cadmium, nickel, or zinc plated. A screened drain hole shall be provided in the lampholder to prevent accumulation of water due to condensation. The mounting hardware of the lampholder shall provide for continuous vertical adjustment of the light beam axis from horizontal to 25° above horizontal. In addition, the mounting hardware shall permit horizontal alignment of the light beam axis to any horizontal angle within ± 1°. The lampholder design shall be such as to provide a waterproof seal for the PAR-38 lamp base when installed. If a gasket is used, it shall provide a tight pressure seal on the back of the lamp to prevent entrance of water into the socket. The gasket material shall be of sufficient thickness and rigidity and shall be suitable to withstand the operating temperature of the glass contact area of the lamp. The lampholder shall be provided with a wireway hole to permit entry of three No. 16 concen-tric stranded wires from the mounting base. The design shall be such that the wires remain internal between the lampholder and mounting base.

3.2.2.3 PAR-38 socket.- The lamp socket shall be the medium screw (medium skirted) type. Insulating materials used in the socket assembly shall be nonporous and nonabsorbent of water. Screw terminals shall be provided on the socket for connection of three No. 16 concentric stranded wires. The socket shall be firmly and rigidly attached to the lampholder with two or more screws in a manner facilitating easy field installation of the three No. 16 wires.

3.2.2.4 Mounting base.- Each PAR-38 lampholder shall be assembled to a mounting base. The mounting base shall have an internal wireway for three No. 16 concentric stranded wires to the lampholder. The lampholder/mounting base interface shall permit passage of the three No. 16 concentric stranded wires regardless of the lamp-holder's vertical adjustment angle (3.2.2.2). The mounting base shall permit rigid mounting of the complete lampholder assembly in either of the following ways:

(a) Capping the open top of a frangible coupling (FAA Drawing C-6046) or using a 2-inch (5.08 centimeters (cm)) electrical metallic tubing (emt) conduit. Three equally spaced (120°) 3/8-inch (0.95 cm) round head stainless steel screws (with slightly cupped tips) shall be provided for this method of attachment.

(b) Mounting into a lamp support as shown on FAA Drawing D-6155-2.

3.2.2.5 PAR-38 lampholder assembly weight.- The maximum combined weight for the lampholder assembly, consisting of lampholder, socket, and mounting base, shall be as specified below:

(a) Maximum combined weight of items covered in 3.2.2.2, 3.2.2.3, and 3.2.2.4(a) shall be 15 ounces (avoirdupois) (425 grams).

(b) Maximum combined weight of items covered in 3.2.2.2, 3.2.2.3, and 3.2.2.4(b) shall be 10 ounces (avoirdupois) (284 grams).

3.2.3 Aiming device.- The contractor shall provide a single aiming device capable of aiming the PAR-38 lamp, the PAR-56 lamp, or the flasher light unit. The aiming device shall be designed to fit over the cover glass of the lamp and be firmly held in place by a pressure plate with adjustable spring tension. The aiming device shall permit field aiming of the lamp axis perpendicular to the plane of the cover glass to any angle from 0 to +25° above the horizontal. The device shall be capable of remotely aiming the PAR-38 lamp or the flasher light unit mounted on low impact resistance structures conforming to FAA-E-2604 or FAA-E-2702. Starting with the structure in the elevated position, the device shall permit an individual to accurately aim the lamp from the ground after lowering the structure a maximum of two times regardless of the tilting direction of the structure. The aiming device shall also be capable of aiming a PAR-38 lamp, a PAR-56 lamp, or a flasher light unit mounted on a frangible coupling (FAA drawing C-6046). The aiming angle shall be indicated on a scale calibrated in 1° intervals and shall be accurate within ±½° of the actual aiming angle with the device attached. The final aimed angle of the lamp with the device unattached shall be accurate within 1° of the actual angle.

3.2.4 Control cabinet

3.2.4.1 General.- The control cabinet shall contain the circuitry and controls required to operate the MALSR system in the remote or local mode. Included in the control cabinet are electrical and mechanical components which provide power and control outputs for intensity steps of both the steady burning and sequenced flasher lights and for the timing sequence of the sequenced flasher lights.

3.2.4.2 Power and control circuitry

3.2.4.2.1 Power circuitry.- Power input to the control cabinet shall be 120/240 volts ±10 percent, 60 hertz, 3 wire. The control cabinet power output to the 15 kilovoltampere (kVA) power transformer shall be provided over a maximum of four conductors to provide the power transformer secondary output voltages specified in 3.2.5. The control cabinet shall provide 120/240 volts alternating current (V ac) power to the power transformer unit and the individual control cabinet (3.2.6.4). When the MALSR system is deenergized, either in the local or remote mode, the high side of the 120/240 V ac should be removed from the transformer.

3.2.4.2.2 Remote control circuitry.- External remote control input signals to the control cabinet shall be 120 V ac and shall not exceed 500 milliamperes (mA). A terminal block meeting the requirements of 3.2.4.3.11 shall be provided in the lower left quadrant of the control cabinet for remote control input. The terminal block shall be identified as TB6, and shall be provided with the terminals listed below:

(a) 120 V ac (terminal 1)

(b) Spare (terminal 2)

(c) Low intensity (terminal 3 connected to terminal 6 with a jumper)

(d) Medium intensity (terminal 4)

(e) High intensity (terminal 5)

(f) Flasher control (terminal 6 connected to terminal 3 for flasher control to the interface unit)

(g) Sequenced flasher lights on/off (terminal 7)

(h) Neutral (terminal 8)

(i) Spare (terminal 9)

Terminal (1) shall be connected by a separately fused (10 ampere fuse) line to a 120 V ac source within the control cabinet. Terminal (3) will be energized (120 V ac) by external control, when either the low, medium, or high intensity step is selected. When terminal (3) alone is energized by external control, the steady burning lights shall turn on to the low intensity step. Terminal (4) will be energized (120 V ac) by external control, when either the medium or high intensity step is selected. When terminal (4) and terminal (3) only are energized, the steady burning lights shall turn on to the medium intensity step. Terminal (5) will be energized (120 V ac) by external control when the high intensity step is selected. When terminal (5), terminal (3), and terminal (4) are energized, the steady burning lights shall turn on to the high intensity step. Terminal (7) will be energized (120 V ac) by external control to turn the sequenced flasher lights on. When terminal (7) is energized, the sequenced flasher lights shall turn on to the intensity step of the steady burning lights as determined by inputs to terminals (3), (4), and (5). Deenergizing of terminals (3), (4), and (5) shall turn off the entire MALSR system. The neutral terminal (8) shall be connected to the neutral bus (3.2.4.2.5). The system, when energized from the off position, shall come on at low intensity and then switch to a higher intensity if a higher intensity is selected. All intensity changes shall be completed within 1.5 seconds of initiating intensity change. The control cabinet shall provide 120/240 V ac intensity step control and 120 V ac timing pulses output to the sequenced flasher lights. The power output to the sequenced flasher lights may be interrupted up to a maximum of 1.5 second, if required, during intensity step change operations. Circuitry shall prevent intensity step changing during the discharge of a sequenced flasher light capacitor.

3.2.4.2.3 Local control switches.- Two manually controlled selector switches shall be installed in the upper right quadrant of the control cabinet. The first switch shall be a labeled five-position switch providing for step control of the system starting with the REMOTE function, as the selector knob is rotated clockwise as listed below:

Labeled Switch Position	Function
REMOTE	MALSR system is controlled by remote control
OFF	MALSR deenergized
LOW	MALSR operating at low intensity step

MEDIUM	MALSR operating at medium intensity step
HIGH	MALSR operating at high intensity step

The second switch, labeled FLASHER, shall be a two-position switch (ON-OFF) capable of turning the sequenced flasher lights on/off only when the steady burning lights are energized. Play and backlash in the switches shall be held to a minimum commensurate with intended operational functions and shall not cause poor contact or inaccurate settings. Each functional position shall be identified by a mechanical stop as well as by position.

3.2.4.2.4 Entrance switch.- A 2-pole 100 ampere (A), 240 V ac, heavy duty, deadfront safety switch equipped with two dual element timelag fuses, shall be provided as the primary disconnecting device in the 240 V ac input service. The operating mechanism shall be quick-make and quick-break. The switch shall break the ac power line immediately after the line enters the control cabinet via terminal block or connector, and before the line reaches other fuses or parts, except as noted in 3.2.4.3.6. The switch shall be mounted in the upper right quadrant of the control cabinet at a location which will provide easy and safe access to the operating handle.

3.2.4.2.5 Distribution panel.- A surface mounting, deadfront, circuit breaker branch circuit distribution panel for 120/240 volt, 3-wire service, including copper neutral bus bar, shall be mounted in the control cabinet and receive input power from the entrance switch. Individual branch circuits shall be used for the power to the sequenced flasher lights, control devices, convenience receptacle, and to the maintenance light, and shall be protected and labeled. The distribution panel shall also contain a copper grounding bus bar which shall be connected with a bare No. 6 copper grounding wire to the control cabinet grounding lug (3.2.4.3.10). The branch circuit breakers shall be thermal magnetic, type QP or QO frame.

3.2.4.2.6 Contactors.- Lighting type contactors of adequate rating and suitable for the intended application shall be provided for on-off switching of power to the sequenced flasher lights plus on-off and intensity step voltage changes to the 15 kVA transformer. The contactors shall be remotely controlled as specified in 3.2.4.2.2, or by the local control switch when operated locally, and shall be installed in such a manner that their operation does not adversely affect other components. Contactors shall be designed for a minimum life of 150,000 intensity step change operations. Contactors shall have an Underwriters' Laboratories approved rating for tungsten lamp loads. Silicon controlled rectifiers (SCRs) may be used to switch power to the transformer for the intensity steps changing. When SCRs are used, filtering for spike elimination is required to prevent interference with other equipment on the same power service.

3.2.4.2.7 Lightning arresters.- The lightning arresters specified in 3.4.7 shall be installed in the control cabinet for all power and control output circuits to the sequenced flasher lights. The arresters shall be wired to terminal blocks specified in 3.2.4.3.11 and shall be properly combined where

necessary to meet circuit voltage requirements. In addition, a lightning surge protecter located inside the control cabinet shall be connected to the control cabinet power input terminal block. All arresters shall meet the lightning transient suppression requirements of 3.3.4.

3.2.4.3 Cabinet.- The cabinet shall be an outdoor, waterproof, dusttight, nonventilated enclosure as specified herein. The cabinet shall be rigidly constructed and shall not distort or bend under normal methods of shipping, handling, and installation. It shall be stainless steel or aluminum. Stainless steel enclosures shall meet the requirement of 3.8.1.2. Aluminum enclosures shall meet the requirements of 3.8.1.3, and shall be anodized in accordance with MIL-A-8625. The cabinet shall be of sufficient size to accommodate all of the necessary components and wiring and provide adequate clearances for field installation and maintenance. It shall have mounting means external to the cabinet cavity, and provision for locking, and shall not have conduit hubs or knockouts. Space shall be provided in the cabinet for all external cable connections. Terminal blocks (3.2.4.3.11) shall be located near the cable entrance to permit terminations of all external power and control wires feeding into the cabinet. Mounting lugs or bolts shall be provided on the back of the cabinet for mounting the cabinet vertically. Internal or external mounting bolts shall not protrude through the cabinet.

3.2.4.3.1 Cabinet door.- The cabinet door shall open from the right side of the cabinet. The door hinge may be internally or externally mounted and shall be corrosion resistant. A doorstop shall be provided for locking the door in a 120° open position. No electrical components or cables shall be attached to the door.

3.2.4.3.2 Door gaskets.- Door gaskets shall be continuous molded gaskets, and shall be resistant to deterioration such as cracking, hardening, or softening under the environmental conditions the equipment will operate in.

3.2.4.3.3 Door handle.- The door handle lever shall have provision for padlocking it closed in the vertical position. The holes for the padlock shall be aligned such that a 3/8 inch (0.95 cm) diameter rod can be passed horizontally through the holes when the door handle is in a locked position. The handle shall activate a two-point shoot bolt to firmly secure the door in the closed position. The door handle shall be within 2° of vertical when locked and shall keep the door completely closed regardless of what type or size of padlock is used.

3.2.4.3.4 Component mounting panel.- A component mounting panel shall be attached to the back interior cabinet wall upon which all principal assemblies shall be mounted. The panel shall be of the same material as the cabinet. A means shall be provided on the panel for attaching all assemblies using single slotted screws with retained fasteners. A minimum of three complete threads in use is required when the screw is in place. Screws and fasteners shall be stainless steel. Components may be mounted via slotted mounting holes. All component assemblies shall have wire leads terminating at screw terminals on terminal blocks or other assemblies such that a component assembly can be removed from the component panel without unsoldering wires.

3.2.4.3.5 Optional component chassis.- The contractor may at his option, provide a horizontal component mounting chassis in lieu of the component

mounting panel. All provisions applicable to the mounting panel shall be applicable to the chassis unless otherwise specified herein. The chassis shall be anodized aluminum or stainless steel of a gage sufficient to support the weight of all components thereon without sagging or distortion, but in no case less than No. 14 B&S gage for aluminum or No. 16 U.S. Standard gage for stainless steel. Rails shall be provided on the interior sides of the cabinet housing, rigidly attached to properly position the chassis in the cabinet. Casters shall be mounted on the front of the chassis for engaging these rails to facilitate removal of the chassis. Front and rear stops shall be provided to further position the chassis within the housing and to prevent the chassis from inadvertently sliding out from the housing. When the chassis is in its normal operating position, provision shall be made for locking it in place whether the cabinet door is opened or closed.

3.2.4.3.6 Maintenance light and convenience receptacle.- A 100 watt, 120 V ac light with a protective wire mesh cover that is grounded shall be installed in the control cabinet to provide adequate illumination for nighttime maintenance operations. The light and receptacle shall each be separately fused and useable although the entrance switch (3.2.4.2.4) is open. A 120 volt, single phase, 15 ampere, grounding-type receptacle with built-in ground fault interrupter (gfi), shall be installed in the control cabinet for maintenance purposes. The gfi shall be located adjacent to or in the receptacle. The gfi shall be a specification grade Underwriters' Laboratories listed device with pushbutton switches to permit manual test and reset operations.

3.2.4.3.7 Wiring diagram plate.- A wiring diagram plate shall be provided which matches the wiring diagram figure provided in the instruction book manuscript (3.13.1) in accordance with FAA-D-2494/1a, paragraph 1-3.9.2.10. The plate shall be mounted on the instruction book holder per 3.2.4.3.8. The plate shall be Type A, F, or H and the color style shall be Style I or IV in accordance with MIL-P-15024.

3.2.4.3.8 Instruction book holder.- An instruction book holder shall be attached to the upper half inside of the control cabinet door. The holder shall form a pocket for an 8½ inch by 11 inch (22 by 28 centimeters) instruction book and shall be made of the same material as the cabinet door. Provision shall be made for attaching a removable wiring diagram plate (3.2.4.3.7) to the front of the holder.

3.2.4.3.9 Elapsed time meter.- An elapsed time meter shall be installed in the control cabinet to indicate the number of hours of operation on the high intensity step position. The meter shall indicate up to 99,999 hours and indicate total time in hours and 10ths of hours. The meter shall be a recycling type and shall be Cramer Type 10055 or equal.

3.2.4.3.10 Ground lug.- A grounding lug shall be provided at the bottom inside of the cabinet. The lug shall have a slotted, hexagonal, green-colored head suitable for No. 6 bare copper ground wire.

3.2.4.3.11 Terminal blocks.- Terminal blocks shall be the enclosed base type terminal blocks for use with pressure type terminals and shall meet the requirements of FAA-G-2100c, paragraph 3.5.34. Terminal blocks shall have 10 percent unused terminals, but not less than two extra terminals per terminal block. Power terminal blocks shall have a minimum of 6 inches (15.24 centimeters

(cm)) clear space at input and output terminals. Similarly, control terminal blocks shall have a minimum of 4 inches (10.16 cm) clear space at input and output terminals.

3.2.5 Power transformer unit.- The power transformer unit for the steady burning lights shall be field installed beside the control cabinet. The rating of this transformer shall be 15 kVA, single phase, 120/240 volt input, 60 hertz and shall be the self-cooled dry type, and suitable for outdoor installation. The transformer when connected to 240 V ac primary input shall supply the output voltages from three secondary outputs as specified below.

Intensity Step	Secondary Output
High	120/240 volts ±0.5 percent
Medium	75/150 volts ±0.5 percent
Low	50/100 volts ±0.5 percent

In addition, taps shall be provided on the transformer primary to permit adjustment of secondary voltages to within ±2.5 percent of the secondary outputs specified above with a nominal supplied voltage primary input between 210 and 250 volts.

3.2.5.1 Rating.- Except for temperature rise, voltage rating, and taps, the transformer shall conform to general purpose transformers of American National Standards Institute Standard No. C89.1 - 1961 on specialty transformers. Transformer temperature rise shall not exceed +80° Centigrade (C) (144° Fahrenheit (F)), above + 55° C (131° F) ambient temperature at 10,000 feet (3,048 meters) elevation. (The maximum permitted temperature rise at sea level to 3,300 feet (1,000 meters) altitude, based on the NEMA 0.5 percent temperature derating factor for every 330 foot (100 meters) elevation above 3,300 feet (1000 meters) shall be 76° C (170° F) with rated load currents in the transformer windings.) Efficiency at rated kVA and 1.0 power factor (pf) output shall be not less than 97 percent. The regulation at unity pf load shall be not more than 2 percent.

3.2.5.2 Transformer cabinet.- An outdoor, raintight enclosure for the transformer shall be made of the stainless steel or aluminum specified in 3.8.1.3, or galvanized sheet steel. Conduit hubs or knockouts shall not be provided. The cabinet shall be of sufficient size to permit easy field installation of cable terminations. Mounting bolts or lugs shall be provided on the back of the cabinet suitable for mounting the cabinet in the vertical position. The cabinet shall be accessible through a raintight screw-held cover. A terminal block as specified in 3.2.4.3.11 shall be mounted below the transformer core. The terminal block shall have terminals of sufficient number and size to accommodate the wiring indicated in figure 2. Internal or external mounting bolts shall not extend through the cabinet.

3.2.5.3 Lightning arrester.- Two external arresters shall be provided for field mounting directly to the transformer cabinet. The arresters will be wired to the transformer power input and output terminal blocks.

3.2.6 Sequenced flasher assembly.- The sequenced flasher assembly, shall consist of two parts, the flasher light unit and the individual control cabinet. The flasher light unit may be installed next to the individual control cabinet on frangible couplings or 2 inch (5.08 cm) emt conduit, or on top of low impact resistant structures with a maximum vertical separation of 40 feet (12 meters) between the flasher light unit and the individual control cabinet.

3.2.6.1 General.- The MALSR system requires five sequenced flasher light units all powered and controlled from the individual control cabinet described in 3.2.6.4. These flasher light units are to be installed in the outer portion of the MALSR and spaced at approximately 200 foot (62 meter) intervals. The flasher lights flash in sequence toward the runway threshold and produce a visual effect of a ball of light moving toward the runway at a high rate of speed. The design of the units shall prohibit random flashing and the flasher lights shall produce flashes only when commanded by the control cabinet. All printed circuit boards shall have conformal coatings. All printed circuit boards shall be keyed to assure connection or insertion only in the proper place. Extender boards shall be furnished for all printed circuit boards. All interconnecting cables shall be rated for a minimum of 1.5 times the maximum expected voltages in the circuit.

3.2.6.2 Photometric requirements.- The flasher assembly shall be designed to produce, through remote control devices and control lines, the following intensities steps.

Intensity Step	Maximum Allowable Effective Intensity (Candelas)	Minimum Effective Intensity (Candelas)
High	20,000	8,000
Medium	2,000	800
Low	450	150

The effective intensity measurements shall be made over a rectangular pattern not less than 10° vertically and 30° horizontally. Corners may be rounded on a 5° radius to determine compliance. After 250 hours of flashing continuously twice per second, the lamp shall produce an effective intensity of no less than 70 percent of initial candlepower and consecutive misses shall be no more than 1 percent. Flash duration shall be not less than 250 nor more than 5,500 microseconds at 50 percent of the peak instantaneous candlepower. The optical system shall be as simple as possible and still meet all other pertinent requirements. The system may consist of reflectors, lenses, prisms, or such other elements necessary to obtain the required light output. All optical elements shall be designed to assure a long life and consistency of photometrics. The lamp and all optical parts shall be firmly held in place to withstand shock and vibration, but shall permit convenient lamp replacement when required. The optical system shall be designed to prevent misalignment during maintenance operations.

3.2.6.3 Operating requirements

3.2.6.3.1 Rating.- The flasher light unit (3.2.6.5) shall consume not more than 350 watts at 240 V ac when measured with a watt-hour meter or thermal

meter giving a steady needle deflection. The input surge current shall not exceed 10 A root-mean-square (rms) or 14.14 A peak at 240 V ac. The unit shall be capable of operating from an ungrounded 240 V ac source. The unit shall be designed to operate reliably with a power input nominal rating of 210 to 250 V ac (full sine wave) with temporary nominal voltage variation not to exceed ± 5 percent.

3.2.6.3.2 Triggering.- The triggering circuit of each flasher light unit shall be located in the individual control cabinet; however, the trigger transformer may be located in the flasher light unit (3.2.6.5). The five flasher light units shall flash in sequence starting at the outermost unit and progressing inward to the flasher unit located nearest the runway threshold. This sequence shall be repeated twice a second (±25 milliseconds) with a time interval between flashes of adjacent units of 35 ± 5 milliseconds. Any remaining time in each sequence shall occur between the flash of the last unit and the flash of the first unit. The design of the triggering circuits shall be such that failure of one or more flasher units will not affect operation of the remaining units. The timing and triggering circuits shall be designed to accommodate a maximum of eight flasher units. Components used in the triggering circuits shall be designed for a minimum life of 63 million flasher operations. The flasher light unit shall operate satisfactorily when located up to 3,000 feet (900 meters) from the control cabinet.

3.2.6.3.3 Intensity step changing.- All flasher light units shall be designed to operate at three intensity step positions as indicated in 3.2.6.2. Complete instructions on accomplishing the step changes shall be included in the equipment instruction book. Intensity step changing of the flasher light units shall be controlled from the control cabinet (3.2.4) utilizing the control cable specified in 3.2.7. All intensity step changing of the flasher light units shall be done with the system operating. If necessary, the control cabinet (3.2.4) may automatically interrupt power to the flashers for a period not to exceed 1.5 seconds during intensity step changing. Circuitry shall be provided to prevent simultaneous step changing and triggering. In the event of loss of intensity step control voltage, the flasher light units shall automatically revert to operation on the next lower intensity step. The design shall be such that no erratic arcing or relay operation occurs during any intensity step change. Components used for intensity step changing shall be designed for a minimum life of 150,000 intensity step change operations.

3.2.6.4 Individual control cabinet

3.2.6.4.1 General.- Each flasher light unit shall be controlled by an individual control cabinet. The cabinet shall house components; such as, input switch and fuses, terminal blocks, triggering circuits , lightning arresters, and a socket that will connect to the flasher tester plug (3.2.8).

3.2.6.4.2 Cabinet.- The cabinet shall be an outdoor, waterproof, dusttight, nonventilated enclosure made of stainless steel or aluminum. When used, stainless steel and aluminum shall be in accordance with 3.8.1.2 and 3.8.1.3, respectively. Aluminum enclosures shall be anodized in accordance with MIL-A-8625. The cabinet shall be of sufficient size to accommodate all of the necessary components and wiring and allow for easy field installation and maintenance. Two 2-inch (5.08 cm) threaded fittings shall be provided on the bottom of the cabinet to allow for the mounting of the cabinet. Mounting lugs

or bolts also shall be provided on the back of the cabinet to enhance the stability of the cabinet by using an additional mounting attachment when necessary. A third fitting on the bottom of the cabinet shall be provided to accommodate a 3/4-inch (1.9 cm) flexible conduit. The 3/4-inch fitting shall be provided with a 3/4-inch plug. Warning signs as specified in 3.12 shall be installed in the cabinet. Accessories for the cabinet shall meet the requirements of 3.2.4.3.1 through 3.2.4.3.5, and 3.2.4.3.10 and 3.2.4.3.11.

3.2.6.4.3 Power and control circuitry.- Control and power signals from the control cabinet to the individual control cabinet via the junction box shall be as follows:

(a) 120 V ac, 1 phase, 60 hertz (Hz)

(b) Neutral

(c) 120 V ac, 1 phase, 60 Hz

(d) Control cable, six pair (maximum), No. 19, for: five trigger signals, one trigger signal return, three intensity signals (1 through 3), one intensity signal return, and two spare wires. The control signals shall be 120 V ac.

The individual control cabinet shall provide the flasher light unit with the following signals:

(a) Anode (signal to anode of flasher light) (No. 10 THWN, maximum)

(b) Cathode (signal to cathode of flasher light) (No. 10 THWN, maximum)

(c) Trigger (signal to ionize the flash tube) (No. 14 THWN, maximum)

(d) Neutral (No. 10 THWN, maximum)

(e) Interlock (signal to interlock switch) (No. 18 AWG)

(f) Interlock (return signal from interlock switch) (No. 18 AWG)

3.2.6.4.4 Input switch and fuse.- Input power shall be controlled by a toggle switch. Circuit overload protection shall be accomplished by a suitably rated fuse mounted in a fuse extractor post. The switch and fuse shall be located in the upper right quadrant of the cabinet. The input terminal of the toggle switch shall be insulated so as to preclude physical injury during maintenance.

3.2.6.4.5 Transformer.- The power transformer shall conform to MIL-T-27 type TF5RX02, size as required. Voltage taps in 20 volt increments from 200 to 260 volts shall be provided on the primary winding to accommodate any supply voltage within the 200 to 260 V ac range. All primary taps shall be brought out to a single terminal block. The secondary winding shall be rated at 250 milliamperes alternating current (ac) and such voltage as necessary to provide the direct current (dc) voltage necessary but not to exceed 2,000 volts at 240 V ac input.

3.2.6.4.6 Lightning arresters.- Lightning arresters shall be installed in the

individual control cabinet for all input power and control output circuits. The arresters shall be wired to terminal blocks and shall be properly combined to meet the transient requirements of 3.3.4.

3.2.6.5 Flasher light unit.- The flasher light unit shall be a single raintight assembly consisting of all items not mounted on or in the individual control cabinet. The lamp housing shall be constructed of stainless steel or aluminum as specified in 3.2.4.3 or of a nonferrous material which is comparable in service life to a stainless steel or aluminum housing over the full range of environmental and operating parameters defined in this specification. The flasher light unit shall be provided with a means for continuous vertical adjustment of the light beam axis from horizontal to 25° above horizontal. The horizontal beam axis shall be perpendicular to the lamp cover glass or window. All components in the lamp housing shall be accessible for maintenance purposes through a door or cover.

3.2.6.5.1 Window.- The flasher light unit shall have a glass window installed to permit the maximum amount of light transmission from the lamp and reflector. The glass shall be aviation white per MIL-C-25050 (ASG) and shall be Class A per MIL-C-7989. It shall be entirely free of bubbles, mold marks, or other imperfections, which might impair light transmission. The glass shall be ¼ inch (6.35 mm) nominal thickness and shall be highly resistant to mechanical impact and abrasion. The gasket surface of all glass shall be either ground or molded to a sufficiently true surface to ensure a tight joint. The window shall be attached to the lamp housing by watertight gaskets made of material specified in 3.8.1.6 and mounted in such a manner that it can be easily removed or replaced.

3.2.6.5.2 Reflector.- A high quality metal reflector with long life reflective surface shall be enclosed in the lamp housing and shall provide the light output and beam spread specified in 3.2.6.2. The reflector shall have a minimum diameter of 7 inches (18 cm).

3.2.6.5.3 Socket.- The lamp socket shall be a plug-in type porcelain socket able to withstand the operating temperature of the flasher lamp. Insulating materials used in the socket shall be nonporous and nonabsorbent. Screw terminals shall be provided on the socket for required wire terminations. The socket shall be attached to the lamp housing with two or more screws in a manner facilitating easy removal or replacement of the socket.

3.2.6.5.4 Mounting attachments.- Each flasher light unit shall be assembled to a mounting base. The mounting base shall have an internal wireway to accommodate the six wires mentioned in 3.2.6.4.3 (a) through (f). The lampholder/mounting base interface shall permit passage of the six wires regardless of the lampholder's vertical adjustment angle. The mounting base shall permit rigid mounting of the complete lampholder assembly in either of the following ways:

(a) Capping the open top of a frangible coupling (FAA Drawing C-6046) or a 2-inch (5.08 cm) emt conduit. Three equally spaced (120°) 3/8-inch (0.95 cm) round head stainless steel screws (with slightly cupped tips) shall be provided for this method of attachment.

(b) Mounting into a lamp support as shown on FAA Drawing D-6213-15

3.2.6.5.5 Flash tube.- The flash tube shall be a plug-in type with a rated life of at least 1,000 hours when operated on the high intensity step. The effective intensity shall not decrease more than 30 percent during the minimum rated life and flash skipping (misfirings) shall be less than 1 percent with no skips occurring consecutively. If the flash tube used is the type which is enclosed in a PAR-56 bulb, then the window (3.2.6.5.1), the socket (3.2.6.5.3), and the reflector (3.2.6.5.2) are not required.

3.2.6.5.6 Flasher light unit wires.- The flasher light unit design shall be such that all wires entering the light unit will fit through a 1/2-inch (1.27 cm) liquid-tight flexible conduit. The flasher light unit shall feature a 1/2-inch fitting that will accommodate the flexible conduit. All such wires shall be single conductor and a maximum of six wires between the flasher light unit and the flasher individual control cabinet shall be used. If a wire with an insulation rating greater than 600 volts is required, the contractor shall provide wires (60 feet (18.28 meters) long) to permit continuous runs from the individual cabinet to a flasher light unit mounted on top of a 40 foot (12 meter) low impact resistance structure.

3.2.6.5.7 Flasher light unit weight.- The maximum weight of the flasher light unit as defined in 3.2.6.5, including the mounting attachments (3.2.6.5.4), shall be 5 pounds (2.25 kilograms).

3.2.7 Junction boxes.- Junction boxes shall be in accordance with FAA Drawing D-5140-2. However, the terminal block indicated in the above drawing shall be of the type specified in 3.2.4.3.11. Also the 1-inch conduit hub shall be replaced by two 2-inch conduit hubs at the bottom of the box. The centerlines of the hubs shall be 8 inches apart. Control and power signal cable from the control cabinet to the junction box shall be as follows.

(a) One conductor No. 10 (120 V ac, 1 phase, 60 Hz)

(b) One conductor No. 10 (neutral)

(c) One conductor No. 10 (120 V ac, 1 phase, 60 Hz)

(d) 6 pair No. 19 (control cable)

3.2.8 Flasher tester.- A flasher tester that monitors the operation of the flasher light unit shall be furnished by the contractor. The tester shall be a single portable unit and shall weigh not more than 20 pounds (9 kilograms (kg)). The tester shall be equipped with a plug that will be connected to a socket in the individual control cabinet (3.2.6.4). The tester shall be capable of testing the line voltages and control signals from the control cabinet to the individual control cabinet. It shall also be capable of testing the power circuits, the triggering circuit of the individual control cabinet, and the power and control signals from the individual control cabinet to the flasher light unit. Indicators shall be provided to monitor all input and output power and control signals of the individual control cabinet. When used, indicator lights shall be readable in sunlight, and indicator meters shall be backlighted for nighttime reading. The tester shall be provided with a built-in voltohmmeter. It shall isolate and furnish data to indicate

satisfactory performance of any functional modules in the individual control cabinet. A flasher tester instruction book in accordance with 3.13 shall be furnished.

3.2.9 Site spare parts.- Each unit of equipment shall include one spare printed circuit board assembly of each type, complete with all components tested and operable.

3.3 Design and construction requirements.- Each unit (3.1) shall be packaged so as not to be affected by rain or any form of atmospheric moisture.

3.3.1 Interlock switches.- Interlock switches shall be incorporated in the individual control cabinet and the flasher light unit so that opening the unit shall (a) disconnect all incoming power and (b) discharge all high voltage circuits. This requirement shall apply even if components which normally draw current from the high voltage circuits are removed. In addition, the design shall provide for permanently connected bleeder resistors to discharge the flasher light capacitors to a maximum value of 50 volts within 1 minute in the event of failure of the interlock switches. Means shall be provided to enable the interlock switch to be cheated with the door in the open position. Energized terminals on interlock switches shall be insulated with heat shrinkable tubing.

3.3.2 Flasher light unit special component requirements.- All material used in the construction and assembly of components, including the insulation of wires which are to be located near or in the lamp chamber, shall be ozone resistant. All components shall be moisture and fungus resistant and suitable for the intended purpose. No components shall be operated beyond the limitations recommended by the manufacturer of the equipment.

3.3.3 Interference requirements.- Conducted interference levels on the power leads, control leads, signal leads, and interconnecting cables between parts, shall not exceed the limits for CE03, as defined in MIL-STD-461 (equipment class ID). Similarly, radiated narrowband and broadband interference levels shall not exceed the limits for RE02 of MIL-STD-461 over the frequency range from 14 kilohertz (kHz) to 400 megahertz (MHz) at a distance of 20 feet (6.1 meters).

3.3.4 Transient suppression.- The equipment shall be designed to withstand transient increases superimposed on the 120/240 V ac (rms) power line input that reach a peak value of 500 V for as long as 50 milliseconds. In addition, the equipment shall be designed to withstand line transients applied at the equipment input power terminals and output interface (excluding remote maintenance monitoring) that are characterized as 10 by 20 microsecond current surges of 10,000 amperes with the subsequent power-followup. The voltages applied to produce the 10 to 20 microsecond waveforms, as defined in ANSI Standard C62.1, shall have a rise time of 10 kilovolts (kV)/microsecond minimum. The equipment shall restart automatically if an interruption or shutdown is experienced due to either type of transient. Equipment operational functions shall be unimpaired by the above transients when each type of transient is imposed a minimum of five times each to the input and output power terminals of the energized equipment. Lightning protectors shall be provided for all power lines at their first point of entry into the equipment, and at their exit from the equipment. The return terminal of the lightning protector

shall be connected to earth ground via a separate dedicated conductor no less than a No. 6 American Wire Gage (AWG).

3.4 Electrical components.- Electrical components shall meet the requirements specified herein unless otherwise noted in other parts of this specification.

3.4.1 Relays.- All relays shall meet the requirements of MIL-STD-454, Requirement 57. In addition, transparent covers shall not be used.

3.4.2 Resistors.- Resistors shall be in accordance with MIL-STD-454, Requirement 33.

3.4.3 Capacitors.- Capacitors shall be in accordance with MIL-STD-454, Requirement 2, except that electrolytic capacitors shall not be used.

3.4.4 Flash capacitors.- All flash capacitors shall be rated at 25 percent above operating voltage and shall be rated as high-energy storage flash-lamp capacitors. They shall have a minimum life of 63 million discharges under ambient temperature range of -55° Centigrade (C) (-67° Fahrenheit (F)) to +70° C (158° F). This required life shall not be derogated by continuous or intermittent operation at working voltage when ambient temperatures are between -55° C (-67°F) and +70° C (158° F).

3.4.5 Inductors and coils.- Inductors and coils shall meet the requirements of MIL-STD-454, Requirement 14.

3.4.6 Diodes.- Diodes shall be in accordance with MIL-STD-454, Requirement 30. In addition, all diodes shall be clip-in units.

3.4.7 Lightning protectors.- Lightning protectors shall be provided for all ungrounded conductors and shall be installed as near as possible to their point of entrance to the housing. The arresters shall be properly combined where necessary to meet the circuit voltage requirements (3.3.4). The return for the lightning protection devices shall be connected to earth ground via a separate dedicated conductor of not less than No. 6 AWG.

3.4.8 Electrical connectors.- Electrical connectors shall be in accordance with FAA-G-2100c, paragraph 3.5.8.

3.4.9 Test points and controls.- Test points shall be provided on all signals that are required to be monitored during checkout, alignment, calibration, or during preventive maintenance procedures, as called out in the system instruction book (3.13.2). Test points shall not be located in compartments with voltage points of 500 volts or more, and all test points shall be located so as to preclude accidental shock to personnel engaged in normal operating or maintenance activities. The removal of components or circuit cards shall not be required to gain access to test points or adjustments. Test point controls and indicators mounted on printed wiring boards shall be accessible from the front of the circuit cage assembly without the use of extender boards.

3.4.9.1 Remote maintenance monitoring and control.- All test points and controls shall be terminated in a central location within the equipment cabinet. The termination shall be a female connector that allows easy connection to an external remote maintenance monitoring system. The connector may also be used during preventive maintenance procedures.

3.5 Environmental requirements.- The equipment shall be designed for outdoor installation and continuous or intermittent operations under the environmental conditions specified below. Procedures for environmental testing shall be in accordance with the applicable paragraphs of section 4, Quality Assurance Provisions. Each type of light system shall be capable of performing satisfactorily under the following environmental conditions.

3.5.1 Temperature.- Temperatures which range from -55° C (-67° F) to +70° C (158° F).

3.5.2 Altitude.- A pressure altitude range from sea level to 10,000 feet (3,048 meters).

3.5.3 Temperature shock.- Exposure of external surfaces (including light windows) to sudden application of cold water when the lights reach stable temperatures.

3.5.4 Humidity.- Relative humidity up to 100 percent including conditions where condensation takes place in the form of both water and frost.

3.5.5 Sand and dust.- Exposure to windblown sand and dust particles as may be encountered in arid regions.

3.5.6 Rain.- Exposure to windblown rain.

3.5.7 Salt spray.- Exposure to salt-laden atmosphere with relative humidity as stated in 3.5.4.

3.5.8 Solar radiation (sunshine).- Exposure to sunshine with ambient temperatures as stated in 3.5.1.

3.5.9 Vibration.- The PAR-38 light units and the flasher light units shall be capable of withstanding vibrations in the frequency range of 10 to 2,000 hertz, in accordance with NEMA Standard FA1-3.01.

3.6 Finishes

3.6.1 Painting.- The individual components of the MALSR system enumerated below shall be painted as follows: All surfaces (interior and exterior) of the lampholder (3.2.2.2), mounting base (3.2.2.4), control cabinet (3.2.4) including door and component mounting panel, power transformer cabinet (3.2.5.2), flasher individual control cabinet (3.2.6.4), flasher light unit (3.2.6.5) including mounting base, and junction box (3.2.7) shall be protected by not less than a primer coat, an intermediate coat, and a final coat of paint. The flasher light unit, if constructed of a nonferrous material, does not require painting if the material color matches the aviation orange color requirements of 3.6.3. If painting of nonferrous material is required to achieve the specified color, the type of paint and method of application with referenced applicable standards shall be approved by the Contracting Officer. The method of application shall produce a finish equal to or better than the finish achieved on metallic surfaces when performed in accordance with this specification.

3.6.2 Surface preparation.- Surfaces to be painted or primed shall be prepared in accordance with MIL-T-704 for Type A surfaces. Surface preparation shall include masking, covering, or otherwise protecting surfaces not to be painted or primed. This includes interface contact surfaces requiring electrical continuity for grounding purposes. Aluminum surfaces shall be anodized in accordance with MIL-A-8625 prior to priming.

3.6.3 Application.- All primer and paint coats shall be applied using a spray method in accordance with MIL-T-704. The prime coat shall conform to TT-P-645 or TT-E-485 for ferrous metal surfaces, TT-P-641 for galvanized metal surfaces, and TT-P-1757 for aluminum surfaces. The color of the primer shall be different from the intermediate coat to provide a color contrast between coats. The intermediate and final coats for all surfaces shall conform to TT-E-489. The exterior surfaces of the control cabinet, the power transformer cabinet (3.2.5.2), the junction boxes, and the flasher individual control cabinets shall be aviation white, Color No. 17875 or 27875, in accordance with Federal Standard 595.

3.6.4 Finish.- The finish appearance of primer and paint coats shall be in accordance with MIL-T-704. The gloss of the intermediate and final coats shall be in accordance with TT-E-489 for the Federal color number of the paint color used.

3.6.5 Conformal coatings.- Conformal coatings shall be limited to type AR, MIL-I-46058.

3.7 Wire and cable

3.7.1 Solid and stranded wire.- Stranded wire shall be used for wires and cables which normally are flexed in use and servicing of the equipment such as at terminal block terminations. In all other applications, either solid or stranded wire may be used, provided that stranded wire shall be used where so indicated by good engineering practice. All conductors shall be copper.

3.7.2 Current rating of wire.- All wires used in making circuit connections shall have a cross-section area-to-current ratio of not less than 500 circular mils per ampere for wire sizes No. 22 American Wire Gage and larger.

3.7.3 Color coding.- All color coding of insulated wires shall be in accordance with the National Electrical Code, NFPA No. 70.

3.7.4 Cabling.- Wiring shall be in accordance with FAA-G-2100c, paragraph 3.5.38, and shall include provisions for strain relief.

3.7.5 Wire terminations.- Wires terminating at screw terminals shall have insulated crimp-on lugs with not more than one wire attached to each lug. Short pieces of plastic insulating sleeving shall be forced over the wire insulation and lugs so as to reduce flexing of the wires at the lugs. No more than two lugs shall be attached to each screw terminal. Nonsoldered wrapped wire connections are prohibited. Soldering is permitted within components or assemblies, and shall be in accordance with MIL-STD-454, Requirement 5.

3.8 Materials and parts.- Materials and parts shall be as specified herein. Materials and parts not specifically designated by part number, standard, or specification shall meet the requirements of FAA-G-2100c, paragraphs 3.6 through 3.6.11. All materials and parts shall be suitable for operation under the environmental conditions specified in 3.5.

3.8.1 Metals.- Metals shall withstand the mechanical stress involved and shall be inherently corrosion resistant or suitably protected after fabrication, to prevent corrosion or oxidation under the service conditions. The use of dissimilar metals in contact with one another shall be avoided wherever practicable. However, if their use cannot be avoided, they shall be in accordance with MIL-STD-454, Requirement 16.

3.8.1.1 Ductile iron.- Heat-treated ductile iron, if used, shall have the proper tensile and yield strength to meet the requirements set forth herein. Particular attention shall be paid to the proper Brinnell hardness and elongation of the material. Protection plating as specified in 3.8.1.4 shall be used on all cast and machined ductile iron surfaces.

3.8.1.2 Stainless steel.- Type 18-8 stainless steel shall be used for all bolts, nuts, and washers. At the option of the contractor, stainless steel may be used for any purpose for which another material is not definitely specified elsewhere herein or elsewhere in the contract specifications, provided that all stainless steels are of the following types:

American Iron and Steel Institute Type Numbers

301	305	316L
302	308	317
302B	309	321
303	310	322
304	314	322A
304L	316	347

3.8.1.3 Aluminum.- Aluminum shall be in accordance with Federal Specifications QQ-A-200/9 and QQ-A-225. Aluminum enclosures shall be in accordance with Federal Specifications QQ-A-250, QQ-A-591, and QQ-A-601. Aluminum castings, if used, shall be impregnated in accordance with MIL-STD-276.

3.8.1.4 Plating.- All iron and steel parts shall be zinc or cadmium-plated in accordance with Federal specification QQ-P-416 or ASTM B633-78.

3.8.1.5 Glass.- Glass used as an optical or structural part shall meet all requirements of this specification which includes the requirements of MIL-C-7989 for Class B glass. Class C glass may be used if required for impact strength. The lamp cover glass or window (3.2.6.5.1) shall be of borosilicate glass having an average Young's modulus of 9.1×10^6 and a Poisson's ratio of 0.2, or equivalent. The glass shall be tempered to withstand thermal shock (3.5.3). Glass parts shall be supported in such a way that they will not be damaged by vibrations, shocks, or deflection of any component part.

3.8.1.6 Gaskets.- Gaskets used at separable joints for cushioning and sealing purposes shall be neoprene and shall be capable of sustained operation at ambient temperatures of -55° C (-67° F) to 70° C (158° F).

3.9 Processes.- All processes used in the assembly or manufacture of equipments for this system shall be suitable for the intended purposes of the equipments.

3.9.1 Brazing.- Brazing shall be in accordance with MIL-STD-454, requirement 59, except that electrical connections shall not be brazed. Paragraph 3.3 of requirement 59 is not applicable.

3.9.2 Soldering.- Soldering shall be in accordance with MIL-STD-454, requirement 5.

3.10 Assembly and marking.- All components shall be properly assembled and marked. Each electrical component or part thereof shall be identified by a reference designation marked adjacent to the physical location of the part in the equipment and readily visible to maintenance personnel. Such identification shall be identical to reference designations used in instruction books for the equipment. All wiring shall be grouped, where possible, color coded, laced into cables, neatly clamped, and properly marked. Marking shall be in accordance with FAA-G-2100c, paragraph 3.9.

3.11 Nameplate.- Each equipment component which has an FAA equipment type number designation shall be furnished with a nameplate, in accordance with FAA drawing C-21216, and FAA-G-2100c, paragraph 3.10. The nameplate shall be fastened to the equipment exterior surface with Type 430 or 18-8 stainless steel rivets or drive screws.

3.12 Warning signs.- All contacts, terminals, and parts having voltages in excess of 500 V (rms) shall be clearly marked "DANGER HIGH VOLTAGE". Warning signs shall be placed as close as possible to the point of danger. Markings shall have red letters (a minimum of 1/2 inch (12.7 cm) high) on a white or clear background.

3.13 Documentation

3.13.1 Instruction book manuscript.- Instruction book manuscripts shall be prepared as required herein.

3.13.1.1 Draft manuscript.- A draft manuscript of the instruction book covering the entire system shall be prepared and submitted in accordance with the requirements of FAA-D-2494/1a except that:

(a) Functionalization, keying, and shading of drawings and text is not required. Theory of operation shall be explained at the hardware level; however, simplified schematic or functional diagrams may be used to explain unusually or complex circuits.

(b) Boolean algebra expressions and truth tables are not required (reference: FAA-D-2494/1a, figure 12).

(c) Printed circuit board illustrations shall be required only to show component placement and reference designations. Circuit wiring paths need not be provided.

(d) Logic principles per FAA-D-2494/1a, paragraph 1-3.9.6, are not required.

(e) Integrated circuit internal details per FAA-D-2494/1a paragraph 1-3.9.1.2, are not required.

3.13.1.2 Final manuscript.- A final "camera ready" manuscript shall be provided as required by FAA-D-2494/2a.

3.13.2 Instruction book.- The Government will reproduce and prepare instruction books from the approved camera-ready copy (3.13.1.2) and furnish copies to the contractor for shipment with the equipment. Two instruction books shall be included with each set of equipment comprising a system and shall be packaged with the control cabinet (3.2.4).

3.14 Maintainability

3.14.1 Maintainability design criteria.- The following maintenance parameters shall be met by the system design:

(a) Mean time to restore (MTTR) - The MALSR system shall have a MTTR of not more than 15 minutes with no single restoration exceeding 3 hours in duration.

(b) Mean periodic maintenance time (MPMT) - The MALSR system shall have a MPMT not to exceed 2 hours per month including routine inspection.

The above values are established under the assumption that spare parts for failed components are available at the site.

3.14.2 Maintainability program

3.14.2.1 Maintainability program management.- The contractor shall have one clearly identified organizational element which shall be responsible for planning, implementing, controlling, and reporting all maintainability tasks required by this specification.

3.14.2.2 Organization.- The head of the maintainability management organization shall have the necessary authority, resources, and access to higher management to enable him to implement and enforce the requirements specified herein. The maintainability management organization may be part of the reliability management organization.

3.14.2.3 Maintainability prediction.- The contractor shall predict maintainability values for the system/equipment. The prediction technique specified shall be used. The prediction technique shall estimate quantitatively the maintainability system/equipment parameter values for the planned design configuration. The quantitative estimates shall be used to judge the adequacy of the proposed design to meet the maintainability quantitative requirements and to identify design features requiring corrective action.

3.14.2.3.1 Early design predictions.- During the early design and development stages, prediction of mean corrective maintenance time shall be prepared and performed in accordance with Procedure III of MIL-HDBK-472. The prediction shall be submitted 15 days prior to preliminary design review (PDR).

3.14.2.3.2 Final design predictions.- During the final design stages of development, predictions of mean corrective maintenance time shall be in accordance with Procedure II of MIL-HDBK-472. The prediction shall be submitted 15 days prior to critical design review (CDR).

3.15 Reliability design criteria

3.15.1 System reliability parameters.- The following reliability parameter shall be incorporated into the system design:

(a) Mean time between failure (MTBF) for the system shall be no less than 2,500 hours. A system failure occurs when output tolerances from the master control unit are exceeded, when intensity step control is lost, when timer signals exceed their voltage or timing tolerances, or when two or more flashers cease to operate within their tolerances.

3.15.2 Reliability program

3.15.2.1 Organization.- The head of the reliability management organization shall have the necessary authority, resources, and access to higher management to enable him to implement and enforce the requirements specified herein.

3.15.2.2 Reliability predictions.- Reliability predictions shall be based on the proposed design and math model of the system element for each mission profile and mode of operation. Predictions shall conform to the requirements for predictions as specified in MIL-STD-785A, paragraph 5.2.2.3, and the following:

(a) Apportion required system probability of mission success to each function.

(b) Determine the reliability of hardware items and other system elements executing or supporting each function.

(c) Reliability estimates and predictions shall be made relating to the mathematical model such as those contained in MIL-HDBK-217. Current estimates and predictions shall be made for each mission or mode of operation.

(d) The reliability of the equipment shall be predicted based on the stresses experienced by the parts using the failure rate information contained in MIL-HDBK-217 and in the Nonelectronic Reliability Notebook, RADC-TR-75-22. No other source of part failure rates shall be used unless specifically approved by the procuring activity. The prediction techniques described in the following paragraphs shall be implemented by the contractor.

3.15.2.2.1 Average stress prediction.- The reliability of the system shall be predicted using average part failure rates in conjunction with generalized part application assumptions. The prediction shall be submitted in accordance with the contract schedule.

3.15.2.2.2 Detailed stress prediction.- The reliability for the system shall be predicted based on failure rates determined from either measured or computed stress for each part used in the system. Detailed reliability stress analysis shall be performed in accordance with MIL-HDBK-217. The predictions shall be based upon the (maximum temperature rise) specified in the detailed specification. An initial stress analysis prediction shall be submitted 15 days prior to the critical design review. The prediction shall be revised, as necessary, during the course of the system development and production effort to reflect any design changes and part substitutions.

3.16 Configuration management.- The contractor shall implement a configuration management program in accordance with FAA-STD-021. As a minimum, the contractor shall submit within 30 days after receipt of contract, a configuration plan for review and approval by the Government.

4. QUALITY ASSURANCE PROVISIONS

4.1 Quality control provisions.- The contractor shall provide and maintain a quality control program in accordance with FAA-STD-013. All tests and inspections made by the contractor shall be subjected to government inspection. The term "government inspection," as used in this specification, means that an FAA representative will witness the contractor's testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements.

4.2 Maintenance and reliability provisions.- The contract shall submit four copies of a maintainability program plan per 3.14.2 and a reliability program plan per 3.15.2 to the Contracting Officer. The Government will require 14 days to review and evaluate. One copy will be returned to the contractor, either with a statement of approval of the plans or a statement pointing out deficiencies requiring correction.

4.2.1 Maintenance and reliability status reports.- Status reports (four copies) on both maintenance and reliability programs shall be submitted by the contractor to the Contracting Officer. These status reports shall meet the requirements of MIL-STD-470, paragraph 5.12, and MIL-STD-785, paragraph 5.6, and may be combined under a single status report document with separate headings.

4.2.2 Maintainability and reliability demonstration test plan.- Four copies of detailed proposed test procedures to be used for maintainability and reliability demonstration testing (4.4.4 and 4.4.5) shall be submitted to the Contracting Officer at least 30 days in advance of the scheduled test start dates. The test plans do not have to be provided in extensive detail in the maintainability and reliability program plans (3.14.2 and 3.15.2).

4.3 Notification of readiness for inspection.- After receipt of approval of test procedures (4.1 and 4.2.2) and test data forms (FAA-STD-013), the contractor shall notify the Government Contracting Officer in writing that he is ready for government inspection. Such notification shall be given in time to reach the Contracting Officer not less than 5 work days before the contractor desires inspection to start.

4.3.1 Invoice submission.- Prior to the first inspection, the contractor shall submit to the FAA representative copies of invoices covering shipment of each item from the supplier's plant to that of the prime contractor. Each invoice shall carry the vendor's certification that each item furnished meets the requirements of this specification. The certification shall be traceable to the part or material manufacturer's quantitative test data pertaining to the specific part or material. Vendor certification does not constitute FAA acceptance of any part or unit of equipment provided under this specification nor release that part or unit from acceptance testing by the contractor.

4.4 Test methods.- Testing of the equipment shall be performed as follows.

4.4.1 Design qualification test.- The first unit of production of each component is designated as the production model. Where the complement of a system and the prescribed manner of testing require the initial production of a group of identical units; for example, five sequenced flasher assemblies, then all members of that group will be referred to hereinafter as part of the production model. The production model shall be subjected to the tests specified in 4.5, as required by table II. The production model and production units of the PAR-38 lampholder shall be equipped with 150-W, PAR-38 lamps while undergoing testing. Any deformation, discoloration, deterioration, or malfunction of the PAR-38 lampholder at the conclusion of each test shall be cause for rejection. The production model and production units after passing the design qualification tests, shall be deliverable items under the contract.

4.4.2 Production unit tests.- Testing of the production units shall start after acceptance of the production model. Tests on production units shall be as specified in 4.5, as required by table II.

4.4.3 Maintainability demonstration tests- Maintainability demonstration tests shall be performed per FAA-G-2100c, paragraph 4.3.6, on the MALSR production model. The tests shall be conducted in accordance with MIL-STD-471 to verify all quantitative maintenance values required by the specification.

4.4.4 Reliability demonstration tests.- Reliability demonstration tests shall be performed per FAA-G-2100c, paragraph 4.3.6, on the MALSR production model. Reliability demonstration tests may be performed concurrently with the 150 hour operational test (4.5.17.1) unless the reliability tests would require interruption of the 150 hour test. Reliability demonstration tests shall be in accordance with MIL-STD-781C, Table C-I, Plan XXIC. All equipment shall be subjected to the test conditions of MIL-STD-781C, paragraph 50.1, during reliability tests, except that no vibration conditions need to be imposed. Equipment shall be duty cycled in accordance with 4.5.17.1.

Table II. Qualification and Production Tests

Test	Flasher Assembly	Control Cabinet	Power Transformer Unit	Aiming Device	PAR-38 Lampholder Assembly	Flasher Tester	Site Spare Parts
Maintainability demonstration 4.4.3	X	X				X	
Reliability demonstration 4.4.4	X	X	X			X	
Visual inspection 4.5.1	X*	X*	X*	X*	X	X*	*
Altitude 4.5.2	X	X	X				
Temperature 4.5.3	X	X	X		X	X	
Sand and dust 4.5.4	X	X	X		X		
Salt spray 4.5.5	X	X	X	X	X		
Rain 4.5.6	X	X	X	X	X		
Humidity 4.5.7	X	X	X	X	X	X	

X = Design qualification tests (production model).
* = Production unit tests.

Table II. Qualification and Production Tests-Continued

Test	Flasher Assembly	Control Cabinet	Power Transformer Unit	Aiming Device	PAR-38 Lampholder Assembly	Flasher Tester	Site Spare Parts
Thermal shock 4.5.8	X				X		
Solar radiation 4.5.9	X	X	X		X		
Vibration 4.5.10	X				X		
Transformer temperature rise test 4.5.11			X				
Transient suppression 4.5.14	X	X	X				
Photometric 4.5.15	X*						
Dielectric 4.5.16	X*	X					
Operational 4.5.17	X*	X*					*

X = Design qualification tests (production model).
* = Production unit tests.

Table II. Qualification and Production Tests-Continued

Test	Flasher Assembly	Control Cabinet	Power Transformer Unit	Aiming Device	PAR-38 Lampholder Assembly	Flasher Tester	Site Spare Parts
150-hour 4.5.17.1	X	X	X		X		
2-hour 4.5.17.2	*	*			*		*
Aiming device 4.5.18	X*			X*			
Flasher tester operational 4.5.19						X*	
Interference 4.5.20	X*	X*					

X = Design qualification tests (production model).
* = Production unit tests.

4.5 Test procedures.- Appropriate loads (incandescent lamps) shall be imposed on the equipments as required to simulate a 15 kilowatt (kW) load. Upon completion of each test (4.5.2 through 4.5.10), the equipments connected as a MALSR system shall undergo at least one operational test cycle, specified in 4.5.17.1 (a) through (f) and the photometric test described in 4.5.15. Upon completion of all tests, test results including derating data shall be forwarded to the Contracting Officer.

4.5.1 Visual inspection.- The equipments listed in 3.1 (a) through (k) shall be visually inspected for workmanship, fabrication, finishing, painting, and adequacy of selected parts.

4.5.2 Altitude test.- The altitude test shall be in accordance with Procedure I, Method 504.1, of MIL-STD-810C. The equipment shall be tested at atmospheric pressures corresponding to sea level and 10,000 feet (3,048 meters) altitude at both -55° C (-67° F) and 70° C (+158° F).

4.5.3 Temperature test.- The high temperature test shall be in accordance with Procedure II, Method 501.1, of MIL-STD-810C, except the temperature shall be +70° C. The low temperature test shall be in accordance with Procedure I, Method 502.1, of MIL-STD-810C, except the temperature shall be -55° C. The 2-hour operational test will start 2 hours after temperature stabilization. Procedure I shall be performed three times.

4.5.4 Sand and dust test.- The sand and dust test shall be in accordance with Procedure I, Method 510.1, of MIL-STD-810C; delete steps 2 and 3 and rotate equipment 120° twice. Air velocity shall be 2,500 ± 500 feet (760 ± 150 meters) per minute.

4.5.5 Salt spray test.- The salt spray test shall be in accordance with Procedure I, Method 509.1, of MIL-STD-810C, for not less than 168 hours. Salt buildup as a result of the test may be removed with tap water.

4.5.6 Rain test.- The rain test shall be in accordance with Procedure I, Method 506.1, of MIL-STD-810C.

4.5.7 Humidity test.- The humidity test shall be in accordance with Procedure I, Method 507.1, of MIL-STD-810C, except that a total of three complete cycles (72 hours) will be required and the maximum temperature shall be +70° C (158° F).

4.5.8 Thermal shock test.- The production model shall be installed as in normal use and operated at maximum intensity until the temperatures have stabilized. At least 3 gallons (11.53 liters) of water at a temperature of 0° C (32° F) +5° C (41° F) shall be sprayed on the top surface. There shall be no cracking of glass or metal.

4.5.9 Solar radiation (sunshine) test.- The test shall be conducted in accordance with Procedure II, Method 505.1, of MIL-STD-810C. The equipment shall be operated for 1 hour during the third cycle when the test item has reached its peak temperature.

4.5.10 Vibration test.- The production models of the flasher light unit and the PAR38 lampholder assembly shall be vibration tested as described below.

(a) Vibration planes.- The test assembly shall be vibrated in three planes or directions as follows:

In a direction perpendicular to the test table (vertically).

Horizontally, parallel to the light beam axis.

Horizontally, at right angles to the light beam axis.

(b) Frequencies.- The test assembly shall be vibrated through a frequency range of 10 to 2,000 cycles per second (cps), in each plane, until the accelerations shown in table III are reached. Duration of each sweep shall be 10 minutes. Electrical continuity through the lamp shall be continuously monitored under full load conditions. If the filament or lamp envelope or both fail at any point in the range of frequencies, the test shall be continued and completed on the fixture alone. Then a new lamp shall be installed and the fixture assembly shall again be vibrated in three planes through the frequencies of 55 to 2,000 cycles at 3 gravity constant (g's). Failure to meet these requirements shall be cause for rejection of the fixture or the lamp mounting method, or both.

Table III. Vibration Test Data

Acceleration in G's	Frequency (Hertz)
0.020 inch double amplitude (displacement)	10-70
5	70-200
10	200-500
15	500-2,000

After the vibration test, the fixture shall be thoroughly examined for mechanical failure of any component, loosening of any part, cracked or broken seals, continuity of electrical circuits, and possible damage to the lamp filaments, supports, etc.

4.5.11 Transformer temperature rise test.- This test shall be conducted on the power transformer (3.2.5) to establish the temperature rise of each winding. The total maximum winding temperature 55° C (131° F) at 10,000 feet (3,048 meters) altitude plus the temperature rise of each winding shall be within the maximum temperature limit set forth for the temperature class material used in the transformer but shall not exceed 135° C (275° F). The resistance method shall be used for calculation of the temperature rise as follows:

$$\text{Temperature rise } (°C) = (234.5^{*} + T_c)\ \frac{(R_h - R_c)}{R_c}$$

where T_c = temperature (°C) corresponding to cold resistance

R_c = cold resistance of the windings

R_h = hot resistance of the windings

*This figure is for copper

4.5.12 Transformer efficiency and regulation.- The power transformer shall be tested for conformance with requirements specified in 3.2.5 and 3.2.5.1.

4.5.13 Sequenced flasher assembly tests.- Tests shall be performed on five sequenced flasher assemblies (3.2.6) to verify power consumption and operating requirements specified in 3.2.6.3.1. All measurements shall be made at the flasher power supply input terminal.

4.5.13.1 Capacitor discharge circuit test.- The flash capacitor discharge circuits provided through the interlock switches shall be tested for conformance with the requirements of 3.3.1.

4.5.14 Transient suppression test.- A surge generator shall be set to superimpose transient levels, described in 3.3.4, on the energized ac power line and control signals output line (excluding remote maintenance monitoring) of the equipment (control cabinet, power transformer unit, and individual control cabinet). The equipment shall be connected as shown in figure 2. The transient levels shall be verified by open-circuit and short-circuit tests prior to testing the equipment. The surge generator, with a preset transient level, shall then be connected to the input power line and output line of the energized equipment. A minimum of five test surges for each transient control level shall be superimposed on the power input and output lines of the energized equipment. Test surges shall be applied between each input terminal and ground and each output terminal and ground, as well as between the input terminals of a circuit pair and the output terminals of a circuit pair. At the conclusion of the test, the equipment shall be subjected to 10 cycles of the operational test described in 4.5.17.1 and tested to verify compliance with the performance requirements of 3.2.6.2.

4.5.15 Photometric test.- Tests shall be performed on all flasher assemblies in accordance with FAA-E-1100 to prove conformance with 3.2.6.2. These tests shall include verification of the following:

(a) Effective intensity along the beam axis at all available intensity levels.

(b) Effective intensity at 12.5° off the beam axis at high intensity.

(c) Flash duration.

In addition, one flasher assembly selected from the production models shall have isocandela plots of its beam intensity provided.

4.5.16 Dielectric test.- A dielectric test shall be made on all equipment components after complete assembly. For power wiring, the test voltage shall be twice circuit voltage plus 1,000 volts, 60 Hz, applied for 1 minute between insulated parts and ground. Control wiring shall be checked in the same manner using 1,000 volts. Components not designed for this test, such as capacitors, diodes, etc., may be disconnected for the test.

4.5.17 Operational test.- All components (including additional steady burning lights) which will be part of a particular MALSR system shall be connected together when undergoing operational tests. The control cabinet, power transformer, and five sequenced flasher assemblies making up each system shall be connected as shown in figure 2. The load on the power transformer shall consist of one hundred 150-W, PAR-38 lamps or any combination of 150-W, PAR-38 and 300-W, PAR-56 lamps that will provide a balanced 15 kW load. The convenience outlet (3.2.4.3.6) shall undergo three tests using an externally faulted source to verify proper operation of the ground fault interrupter and reset operations. Operation of the flasher light unit and individual control cabinet shall be attempted with the interlock switches in the open position to verify proper operation of the interlocks. All operating requirements of the equipment shall be checked over the full range of voltage input variations at the control cabinet power input terminal (3.2.4.2.1). The step operation of the components shall be verified through the remote control inputs (3.2.4.2.2) provided in the control cabinet.

4.5.17.1 One hundred and fifty (150) hour test.- A 150 hour continuous operation test (in an ambient temperature of +30° ± 10° C (+86° ± 18° F)) shall be performed on the production model. All intensities shall be checked using the remote control inputs to cycle the system as follows:

(a) Low intensity - 5 minutes, ± 1 minute.

(b) Off - 2 seconds, maximum.

(c) Medium intensity - 5 minutes, ± 1 minute.

(d) Off - 2 seconds, maximum.

(e) High intensity - 5 minutes, ± 1 minute.

(f) Off - 60 seconds, ± 10 seconds.

(g) Repeat cycle for 50 hours, starting with (a).

(h) Low intensity - 1 second, ± 0.2 second.

(i) Medium intensity - 1 second, ± 0.2 second.

(j) High intensity - 1 second, ± 0.2 second.

(k) Off - 17 seconds ± 3 seconds.

(m) Repeat cycle for 100 hours, starting with (h).

The local control switch shall be manually cycled through the OFF, LOW, MEDIUM, and HIGH intensity step positions a minimum of 20 times at the completion of the 150 hour test.

4.5.17.2 Two hour (2) test.- All production units shall have a 2 hour continuous operation test (in an ambient temperature of +30° ± 10° C (+86° ± 18° F)) performed on them using the remote control inputs as follows:

(a) High intensity - 1 hour, ± 2 minutes.

(b) Cycle 4.5.17.1 (a) through (g) - 1 hour ± 2 minutes.

The local control switch shall be manually cycled through the OFF, LOW, MEDIUM, and HIGH intensity positions a minimum of 20 times at the completion of the 2 hour test.

4.5.18 Aiming device test.- The contractor shall provide an aiming platform for mounting the lampholder assembly and the flasher light unit and testing each aiming device. The platform shall be calibrated to the same tolerances specified for the aiming devices and shall permit verification of the angular readings taken from the mounted aiming devices from 0° to 25° in 5° increments.

4.5.19 Flasher tester operational test.- The tester operational test shall demonstrate the operation of all the test functions provided in the flasher tester (3.2.8). The test shall show that the flasher tester is calibrated.

4.5.20 Interference test.- The equipments shall be connected as shown in figure 2. Measurement of the conducted emission levels shall be in accordance with test method CE03 of MIL-STD-462. Measurement of the radiated emission levels shall be in accordance with test method RE02 of MIL-STD-462.

4.6 Test instruments.- The manufacturer or the testing laboratory performing preproduction tests shall provide adequate instrumentation for these tests. All instruments shall have calibration labels indicating that the instruments have been calibrated by a reliable laboratory within a period of 6 months prior to the beginning of tests on the flasher equipments. Oscilloscopes and photometric equipment shall be calibrated prior to performing the first test, and if necessary every 3 months after completion of the first test. Indicating instruments, voltmeters, and ammeters shall be of the 1/2 of 1 percent classification or better. Alternating current instruments shall be true types. Temperature sensing elements shall be thermocouples. Each thermocouple shall be pretested by inserting it in a chamber of known temperature. The thermocouples shall be installed at points determined by the FAA representative. The thermocouples shall be secured in place with high temperature cement manufactured for this purpose (Sauereisen cement or equal).

4.7 Test performance.- All tests described above shall be performed at the contractor's expense at the contractor's facility or at an FAA approved independent testing laboratory. All tests shall be witnessed by an FAA representative. Tests shall be conducted on the production model and on production units as outlined above to provide compliance with this specification.

5. PREPARATION FOR DELIVERY

5.1 General.- The equipment shall be prepared for delivery in accordance with the following subparagraphs.

5.1.1 Packaging.- Packaging shall be in accordance with Specification MIL-E-17555, Method III. Separate packaging shall be provided for each optical assembly and outer ring assembly.

5.1.2 Packing.- Packing shall be in accordance with Specification MIL-E-17555, level A.

5.1.3 Marking.- Packages shall be durably and legibly marked with the following information:

Quantity _____
Type _____
Style _____
Specification Number _____
Contract Number _____
National Stock Number _____
Manufacturer's Name or Trademark _____

6. NOTES.- The contents of the subparagraphs below are only for the information of the Contracting Officer. They are not contract requirements, and are not binding on either the Government or the contractor except to the extent that they may be specified elsewhere in the contract as such. Any reliance placed by the contractor on the information is wholly at the contractor's own risk.

6.1 Deliverable items.- The MALSR system shall consist of the following items which are to be called out in the contract documents as deliverable items under this specification:

(a) Lampholder for PAR-38 lamps

(b) Lampholder for PAR-56 lamps

(c) Sequenced flasher assembly

(d) Control cabinet

(e) Power transformer

(f) Aiming device

(g) 2 Mating connectors for remote maintenance monitoring

(h) 2 Mating connectors for flasher tester and individual control cabinet

(i) Manuscript plan for equipment instruction book

(j) Draft manuscript for equipment instruction book

(k) Reproducible (camera-ready) copy of equipment instruction book

(m) Flasher tester

(n) Manuscript plan for flasher tester instruction book

(p) Draft manuscript for flasher tester instruction book

(q) Reproducible (camera-ready) copy of flasher tester instruction book

(r) Early design predictions, maintainability predictions

(s) Final design predictions, maintainability predictions

(t) Average stress prediction, reliability predictions

(u) Detailed stress prediction, reliability predictions

(v) Maintainability program plan

(w) Reliability program plan

(x) Status reports

(y) Quality assurance test procedures

(z) Maintainability demonstration test plan

(aa) Reliability demonstration test plan

(ab) Site spare parts for each unit of equipment

6.2 Scheduled events.- The following scheduled events are to be included in the contract: (a) preliminary design review and (b) critical design review.

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